Early Acheulean Stone Tools and Fossil Faunas
From the Dauqara Formation,
Upper Zarqa Valley, Jordanian Plateau

Fabio Parenti, Abdel Halim Al-Shiyab, Ernesto Santucci, Zeidan Kafafi, and Gaetano Palumbo
with an appendix by Claude Guérin

Abstract: We present the results of a joint Italo-Jordanian mission in the upper Zarqa Valley in the Jordanian plateau. The chronostratigraphic sequence, formerly proposed, has been confirmed. It has three inset terraces comprised between at least the Middle Pleistocene and the Holocene. The uppermost one is a pediment composed of the Dauqara Complex, a mixed alluvial-colluvial formation. The middle terrace embraces both the Bire (upper Acheulean) and the Khirbet-Samra formation (Mousterian). The lowermost terrace is of Holocene age. This paper especially deals with 19 sections in the Dauqara Formation. One of these sections, near the village of Sukhne, yielded mammalian fossilized faunas and a rich flake industry. Identified teeth pertain to Mammuthus meridionalis, Equus cf. tabeti and Bos primigenius. The fauna is comparable with the one found at the Israeli site of 'Ubeidiya, dated at 1.4 my, but slightly more evolved. The 243 artifacts from the whole formation are quite peculiar in the context of Levantine Acheulean: there are no handaxes nor spheroids; there is just one chopper and a majority of globular cores. The debitage is composed of heavy flakes with cortical or plain butts, with rare centripetal flake-scars. All of the characteristics of the site allow a preliminary chronology at the beginning of biozone 20 between 0.9 and 1 my. A comparison is proposed with the most important sites of the Lower and Middle Acheulean in the Levant.

Introduction

The Palaeolithic archaeology of the Levantine Rift is one of the key areas for the study of the spread and adaptation of the genus Homo outside Africa. The presence of Homo erectus in the Levant is dated at 1.4 million years at the fluvio-lacustrine site of 'Ubeidiya in the Jordan valley, which can be referred - in biostratigraphic terms - to the biozone 19 or Upper Villafranchian age (TCHERNOV and
Lithic industries in this site show an evolved Oldowan or lower Acheulean character (BAR-YOSEF and GOREN-INBAR 1993, GUÉRIN et al. 1993). Other Levantine sites in different stratigraphic contexts have also been assigned to the Early Acheulean: Borj Kinnarit and Sitt Markho in Lebanon (HOURS and SANLAVILLE 1972, SANLAVILLE 1979), Kefar Menahem in Israel (BAR-YOSEF 1994), Khattab in Syria (COPELAND and HOURS 1993). In Jordan the assemblage of Abu Habil (HUCKRIEDE 1966) was formerly assigned to the Oldowan and the nearby site of Abu el-Khas has been correlated to it (VILLIERS 1980, 1983). Recent reappraisals of the East bank stratigraphy refute such an early date (WALMSLEY et al. 1993). Middle Acheulean sites have been reported in Tabqaqt Fahl formation, near Pella (MACUMBER 1992, WALMSLEY et al. 1993, WRIGHT 1993) and in the upper Zarqa Valley. The latter area is the subject of this report. The Late Acheulean technocomplex is ubiquitous and well known all over the southern Levant. For the sake of brevity, the main problems of early prehistory in Jordan could be synthesized as: 1) the lack of absolute dates for the Lower and Middle Pleistocene; 2) the absence of fossilized mammalian faunas prior to the Upper Pleistocene; 3) the uncertainty about the first peopling of the eastern side of the Jordan Rift.

In this paper we report on the results of new research in the upper Zarqa Valley, focusing on the problem of the oldest peopling of the area in the context of the Early and Middle Acheulean of the Levant.

The Region and the Dauqara Formation

History of Research

The first systematic work in the Zarqa-Dhulhayil Valleys was conducted by a French team of the University of Lyon (BESANÇON et al. 1984, BAUBRON et al. 1985, BESANÇON and HOURS 1985, BESANÇON et al. 1992, COPELAND and HOURS 1988). The important and useful results of the two fieldwork seasons (1980, 1981) allowed the recognition of at least three Pleistocene artifact-bearing terraces, along with the absolute dating of the Pliocene basalt flows.

Since 1993 an Italo-Jordanian archaeological project has been carried out in the area1. The aim of the project is to reconstruct the cultural landscapes during different periods and episodes of human occupation, from early prehistory to modern times.

During the 1993 field campaign, prehistoric research in the area was limited to the identification of the sites discovered by Besançon and his colleagues and to a general diachronic outline of prehistoric settlement based on a number of sites located on the surface by our survey team. The sites ranged in date from the Late Acheulean to Neolithic, but other research priorities during this first campaign did not allow a more careful study of the industries found, nor a general geo-archaeological survey. One of the priorities of the 1996 campaign (the second field season) was to confirm the sequence proposed by Besançon and his team and to investigate the uppermost formations for the presence of artifacts and palaeontological remains. This optimistic objective was supported by observing the intensive agricultural activities and infrastructure development of this area, which included extensive bulldozing and terracing of wadi banks, especially in the vicinity of the village of Sukhne where the most consistent outcrops of the Dauqara Formation were to be found. The relative chronology proposed by Besançon and his colleagues, along with their reported field observations, had maximum value for our survey. Not only has their scheme been fully confirmed, but this previous comparative knowledge of the industries has oriented our analysis towards an extra-regional perspective.

The Region

The East bank of the Jordan River is cut by several wadis running westward from the central Jordan ridge. The Wadi Zarqa basin drains the western border of the Jordanian plateau, running northward from the city of Amman to the Zarqa-Dhulayil confluence and westward from the latter to the Jordan Valley (Fig. 1).

The present climate in the region is arid, with an average annual rainfall of 166mm (1950-1980). The original steppic vegetation has been destroyed by overgrazing and extensive use of tractors in the river banks. In the southwestern portion the landscape is dominated by rounded hills of Upper Cretaceous limestone (maximum elevation 880m) steeply dissected by the river. On the northeast, in the Dhulayil sector downstream of El-Hashimiya, several Pliocene basalt outcrops with a flat-topped morphology overly the base of limestone hills.

---

1 The project is co-sponsored by the Universities of Rome and Yarmouk (Irbid), and it is directed by Zeidan Kafafi, Gaetano Palumbo, and Paolo Matthiae.
Fig. 1. The Zarqa-Dulhail Valley <outcrops of Daqara Formation dotted>.
The basalts provided the only radiometric datings available in the region (BAUBRON et al. 1985). They span between 7 and 2.3my. The last basalt flow (B4) is clearly visible in the Dhulayil Valley at the bottom of upper Pliocene and Pleistocene alluvial sequence.

Three main Quaternary inset terraces have been defined in the valley. The uppermost (40-60m above river level) is a mixed pediment-alluvial unit, essentially composed by the Dauqara Formation with limestone slabs and alluvial pebbles. From Baubron et al. (1985), it is possible that the Dauqara Complex embraces several alluvial and colluvial units, spanning from Final Pliocene to Middle Pleistocene. As we can see below for the Sukhne sector, a consistent amount of the whole formation does contain cultural remains. The intermediate terrace (40-15m) is composed of the Biré and Khirbet Samra alluvial formations, both very rich in artifacts. The first is dated to upper Middle Pleistocene and contains a consistent Acheulean industry, and the second is dated to the Upper Pleistocene, containing a Middle Palaeolithic flake industry. The lower terrace, a few meters above the present river bed, is composed of the Sukhne Formation, of upper Holocene age.

The Sites

The core of Dauqara outcrops has been mapped by Besançon and coworkers as roughly comprising the flat landscape between the limestone hills south of Sukhne and the 500m contour line on the western and northern edges of the plateau. This includes an area of about 1.35km²; about one third of this area is currently occupied by modern buildings and roads. The remnant is devoted to irrigation terrace agriculture. An extra 0.3km² are dispersed on some terraces on the west bank of the Zarqa, 3km north of the homonymous town. Some 0.5km² were mapped in the environs of Jebel Bakjie, but no visible section was exposed at the time of our survey, fall 1996 (BAUBRON et al. 1985, Fig. 1). Other outcrops, northward of the small village of Biré, will be checked during the next field seasons.

Table 1. Sections and lithic industries of Dauqara Formation <PGN: Palestine Grid North; PGE: Palestine Grid East>.

<table>
<thead>
<tr>
<th>N</th>
<th>PGN</th>
<th>PGE</th>
<th>H. top</th>
<th>H. bottom</th>
<th>Choppers</th>
<th>Cores</th>
<th>Debitage</th>
<th>Retouched</th>
<th>Chunks</th>
<th>Undet.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>330</td>
<td>172.37</td>
<td>250.85</td>
<td>506.17</td>
<td>503.17</td>
<td>-</td>
<td>11</td>
<td>85</td>
<td>23 (+12?)</td>
<td>1</td>
<td>3</td>
<td>145</td>
</tr>
<tr>
<td>331</td>
<td>172.75</td>
<td>250.75</td>
<td>502.00</td>
<td>496.13</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>332</td>
<td>172.35</td>
<td>250.73</td>
<td>506.71</td>
<td>503.31</td>
<td>-</td>
<td>2</td>
<td>6</td>
<td>1 (+1?)</td>
<td>1</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>334</td>
<td>172.10</td>
<td>250.57</td>
<td>500.46</td>
<td>485.00</td>
<td>-</td>
<td>4</td>
<td>8</td>
<td>3 (+2?)</td>
<td>2</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>335</td>
<td>172.66</td>
<td>247.38</td>
<td>c. 485</td>
<td></td>
<td>-</td>
<td>1</td>
<td>2</td>
<td></td>
<td>-</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>336</td>
<td>172.67</td>
<td>247.33</td>
<td>c. 485</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>337</td>
<td>172.61</td>
<td>247.36</td>
<td>c. 485</td>
<td>481.5</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>2 (+2?)</td>
<td>-</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>338</td>
<td>172.73</td>
<td>247.97</td>
<td>c. 481</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>339</td>
<td>172.79</td>
<td>249.38</td>
<td>c. 507</td>
<td>c. 501.5</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>340</td>
<td>172.74</td>
<td>249.90</td>
<td>509.94</td>
<td>506.94</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>341</td>
<td>169.88</td>
<td>249.96</td>
<td>526.00</td>
<td>516.07</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>342</td>
<td>167.96</td>
<td>249.99</td>
<td>550.75</td>
<td>549.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>343</td>
<td>167.80</td>
<td>250.12</td>
<td>550.50</td>
<td>544.01</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>344</td>
<td>171.35</td>
<td>251.12</td>
<td>c. 518</td>
<td>c. 516</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>345</td>
<td>171.87</td>
<td>251.87</td>
<td>c. 515</td>
<td>c. 513</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3 (+3?)</td>
<td>-</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>346</td>
<td>171.91</td>
<td>252.11</td>
<td>c. 513</td>
<td>c. 505</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>1 (+1?)</td>
<td>-</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>347</td>
<td>172.87</td>
<td>250.90</td>
<td>c. 498</td>
<td>495.15</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>348</td>
<td>172.31</td>
<td>250.79</td>
<td>c. 505.5</td>
<td>c. 503.5</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
<td>2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29</td>
<td>136</td>
<td>70</td>
<td>2</td>
<td>5</td>
<td>243</td>
</tr>
<tr>
<td>%</td>
<td>0.41</td>
<td>11.93</td>
<td>55.97</td>
<td>28.81</td>
<td>0.82</td>
<td>2.06</td>
<td>100</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

A total of 85 sections were recorded and described during the 1996 survey. Nineteen of these are attributed to the Dauqara Formation, as previously defined by the French team, on the basis of: a) topography: elevation above the present river bed and grid references compared with the maps reported in Baubron et al. (1985) and Besançon and Hours (1985); b) morphology: concave surface of pediment instead of lower flat river terraces; c) sedimentology: granulometry, lithology and sedimentary structures. The sections and their archaeological content are listed in Table 1.

The sections have been cut by bulldozers in the last 15 years. Because of the scarcity of rainfall, the front is generally steep, clean and devoid of vegetation, a condition which provides for good visibility. In several circumstances another set of sections was bulldozer-cut just below and nearby an

---

1 For the sites recovered in these formation, see PALUMBO et al. 1997.
Fig. 2. Sections of Dauqara Formation
(1 limestone crust, 2 gravel, 3 sand, 4 silt, 5 presence of artifacts, 6 colluvium).
upper one. In this (rare) case we have a sequence within the same formation. It is the interesting case of sections 342-343 (Fig. 2) which have a planimetric distance of about 50 metres and display a perfect continuity from a stratigraphic point of view. The majority of locations has been recorded on the top of the formation, with an uppermost limestone crust sealing the all of the strata. Within the same formation, the artifacts recovered at the bottom should be the oldest.

The crust is a typical caliche formation, between 0.3 and 0.7m thick, including sands and gravel lenses. At the bottom the carbonaceous accretion is gradual (tuffaceous crust); the top is a hard and consistent limestone slab. In many cases we found artifacts inside the crust as well as below (Sections 404-407, Fig.2). Sometimes the industries recovered just below the crust in fine-grained sediment appear in surprisingly fresh condition, as in the case of section 332 (Fig. 5:1,7,8). Above the crust we often observed a colluvial deposit: angular limestone clasts, cobbles, and poorly sorted sands. In some cases it seems to be the remnant of ancient colluvia, because the sediment, although unstratified, is well compacted and the artifacts in it are homogeneous, generally pertaining to Late Acheulean. In other cases it is clearly the by-product of modern terrace-building earthworks: sedimentary matrix is absent and different industries as well sherd are visible.

Site 330 Sukhne North

Topography and Stratigraphy

The position of Section 330 is typical of the large majority of localities explored in Dauqara formation: just at the nickpoint between the pediment and the talweg. The section is oriented NW-SE, i.e., almost parallel to the modern Wadi Dhulayil. It is about 30m long and between 1 and 2.5m high. Its top was surveyed at 506m above sea level. At the bottom there is a cultivated field. Agricultural work on the top stopped at about 4m from the front.

So far we have been able to examine only the upper part of the section and have not conducted any excavation at the bottom. This is the reason why we describe the stratigraphy from the top (Fig. 3):

1) Colluvium: sand and pebbles with no visible sedimentary structures; it is the current ploughzone, affected by agricultural activity. On the surface we recovered Late Acheulean bifaces.
2) Limestone crust: homogeneous, hard, tuffaceous at the bottom. Because of its height above the present surface and patina, we cannot confirm the presence of artifacts inside.
3) Channel-bed structures with sand and gravel lenses, sometimes reddened. We provisionally subdivided this unit into three sub-units, which could also represent nothing more than a lateral variation of facies. They are:
   3a) colluvial lenses in a sandy-cemented matrix;
   3b) graded gravel with cobbles and pebbles in a fine-gravel/ sandy matrix; a yellowish-brown (10/5.6) band is visible on the top (oxidized layer ?);
   3c) mainly colluvial lenses in sandy cemented matrix. All the sub-units contain artifacts, but unit 3c, explored only at its top, is the richest artifact-bearing layer. The teeth were found in sub-unit 3b.

Palaeontology

Right at the beginning of the 1996 campaign, a fossilized tooth visible in the lowest portion drew our attention to Section 330. In the three days of work on the site, we recovered four more teeth and a fragment of long bone of small ruminant (probably gazelle). One of the teeth, a large fragment of elephantine molar, was submitted to Claude Guerin for further analysis (see below). One is a lower premolar of Equidae and three are upper molars of Bovidae.

Equidae

The exact position of an isolated equid tooth is difficult to identify, particularly P3-M2. The specimen belongs to Equus sp. and is probably the first molar (M1). This lower right first molar is badly preserved as it is broken in the lower third portion. In the Double Knot, the metaconid is larger and higher than the metastylid. The lingual groove (or lingualiflexid, which is located between the metaconid and the metastylid) is almost V-shaped and slightly open at the lingual surface, and the lingual edges of the metaconid and the metastylid are convex. The vestibular groove between the protoconid and hypoconid is very deep. P. Turnbull and C. Reed (1974), S. Davis (1980), and V. Eisenmann (1980,1986) described in detail the morphology of teeth in different equid species, and they mentioned that if the lingual groove of the Double Knot is V-Shaped and the pli caballine is absent, the tooth will refer to the stenonian type. The morphology of the tooth of Sukhne North is typically stenonian because the lingual groove of the Double Knot is very narrow, deep and V-
shaped. This tooth is definitely not hemion because hemion is characterized by the concavity and shortness of the lingual groove (EISENMANN 1986).

Eisenmann (1986) mentioned that there is one species of Equidae at 'Ubeidiya: E. cf. tabeti. With a further revision of the Pleistocene horse of Lathamne, Eisenmann proposed for the 'Ubeidiya horse the definition of Equus cf. altidens, Equus cf. tabeti becoming junior synonym of it (GUÉRIN et al. 1993b). The fossil tooth of Sukhne North refers to the species E. tabeti - the first specimen recovered in Jordan - because the size and morphology are more or less similar to the one found at 'Ubeidiya. The dimensions are smaller, but the postflexidic index is almost the same as E. cf. tabeti of 'Ubeidiya (Table 2).

Table 2. Measurements of the first inferior molar of equids. LO = occlusal length; LF = length of postflexid; lo = maximal width; postfl. i = postflexidic index = (LF x 100) / LO.

<table>
<thead>
<tr>
<th>Site</th>
<th>LO</th>
<th>LF</th>
<th>lo</th>
<th>postfl. i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sukhne North</td>
<td>23</td>
<td>8.2</td>
<td>13</td>
<td>35.6</td>
</tr>
<tr>
<td>Ubeidiya</td>
<td>26.3</td>
<td>9.3</td>
<td>14.7</td>
<td>35.2</td>
</tr>
</tbody>
</table>

Bovidae

We describe here only the permanent tooth. It is a well preserved upper first molar tooth of Bovidae (M1). The parastyle, mesostyle and metastyle are very developed and mostly parallel to the axis of the tooth. The paracne and metacone are also present and are round-shaped. The posterior corner of the prefossette is higher than the anterior corner of the postfossette. The measurements of this tooth are almost within the range of the Aurochs (Bos primigenius).

The small fragment of long bone of small ruminant is undeterminable, although it is possible that this shaft femur could belong to Gazella sp.

Hypothesis on the Genesis of the Site

The sedimentary structures visible in Section 330 are related to a palaeomorphology in which the river bed of the Zarqa-Dhulayil Valleys - in existence since the lower Pliocene - were well above the present elevation. Its small tributaries would have eroded the upper pediment during the rainy season. Because Section 330 is roughly parallel to the Dhulayil course, the palaeochannels we observe are roughly cross-cut by the current front of the section. Some of the filling units would have experienced a sedimentation break with subsequent chemical alteration. This fact points to a broad time span in which several episodes of erosion, sedimentation and exposure would have contributed on the whole to the formation of Stratum 3. As already pointed out by Baubron et al. (1985: 278), the Dauqara Formation is probably polycyclic and polygenic, combining both alluvial and colluvial origins. This means that we are facing, at least in Section 330, a secondary "site": lithic and faunal remains, discarded on the top of the plateau, were transported and dismembered by the surface waterflow for an unknown distance and sometimes concentrated in the channel beds. Such taphonomic situations are well known in Pleistocene archaeology and palaeontology. Some of the sites at Olorgesailie (Middle Pleistocene, Kenya) or the palaeontological locality of Saint Vallier (Middle Villafranchian, France) are two of the clearest examples of this pattern (ISAAC 1977, DÉBARD et al. 1994).

Lithic Industries of Dauqara Formation

Composition

The assemblage presented here is a pooling of all the sections attributed to the Dauqara Formation, i.e. a total 243 artifacts. It is composed of 29 cores (12%), 135 products of debitage (56%), 71 tools (29%, of which 9% has dubious retouch), 7 chunks and undeterminables (about 5%). The 49 (proper) tools are: retouched flakes (41%), notches (24.5%), scrapers and denticulates (18.5%), rare awls (4%) and truncations (4%); just one specimen each for raclette, end-scraper, point, chopping-tool. Only two tools were made on a core. Both the cores and the chopping-tool have large cortical surfaces. The recurrent cores have been classified here as discoidal and globular. Some cores of other Levantine sites, morphologically very similar, have been considered as "pebble tools" and defined as discoids or polyhedrons. 'Ubeidiya is the best example (BAR-YOSEF and GOREN-INBAR 1993). The only real difference is the number of flake-scars and the regularity of shape, both poor in the Dauqara case. Till now, we do not have any handaxe or real, well-shaped polyhedrons.
Fig. 4. Section 330: 1 utilized flake, double patina (330-2); 2 retouched flake, double patina (330-29); 3 awl (330-73); 4 flake (330-94); 5 flake (330-39); 6 notch (330-100); 7 retouched flake (330-41); 8 orthogonal core (330-120); 9 unidirectional core (330-22); 10 denticulate (330-67); 11 flake (330-57).
Fig. 5. Artifacts from several Dauqara sections. 1 denticulate (332-4); 2 elongated flake (344-1); 3 discoidal core (342-4); 4 flake from discoidal core (342-5); 5 retouched flake (342-2); 6 chopping-tool (331-1); 7 flake, with heavy whitish patina and fresh edges (332-2); 8 elongated flake (332-6).
Surface Conditions

All the Dauqara artifacts show some degree of rolling and smoothing of the edges. We measured the amount of rounding with the Shackley method. The index ranges between 1 and 6, the latter value being the maximum (SHACKLEY 1974). Of the whole industry, 4% of tools are fresh, 75% slight abraded or abraded and 21% heavily or very heavily abraded. The average value for Dauqara Formation is 3.8. Rolling in the lowermost Middle and Upper Pleistocene terraces is much lower: 3.3 for the 178 artifacts of Biré Formation and 3 for the 77 artifacts of Khirbet-Samra Formation. About 19% of the artifacts are fractured. As regards patina, because of the high subjectivity of this kind of evaluation, we prefer to wait for a more advanced study. Nevertheless, we noted that about 8% have a clear double patina and that, on the whole, the colour is brownish-gray. In many cases we noted marginal retouch, generally old, sometimes isolated, other times extensively distributed on the edges in an apparent disorder. In some cases we classified them as pseudo-retouch or macro-wear; in others they totally hampered the reading of possible real retouch, forcing us to a provisional classification.

Technology

So far, the Dauqara assemblage seems to be mainly a flake industry. If we consider the size of cores and debitage, we can argue that it was produced from large siliceous pebbles: average weight of cores is 206 g, average length 77mm (debitage 29.3 g, 53mm). Among the cores the unidirectional type is most common (31%). Globular cores make up 17%, sub-discoidal 14% and sporadic 7%. The number of flake-scars\(^1\) ranges between 6 and 9, with the maximum in the globular type and the minimum in the unidirectional type. As regards the amount of cortex, the average value for the cores is 2.5 (in a range 1-5); it covers half the dorsal face in more than 50 of the 100 measured complete flakes. Whereas totally cortical flakes are 14.4%, the debitage without any cortex is less than 2%. Moreover, among the 164 preserved and recognizable butts, cortical platforms are at 44.5%, flat/plain 40.9%, linear and punctiform 6.2%, dihedral 6.2%, and facetted 1.8%. The average number of flake scars on the dorsal face is 2.5 and the average flaking index, defined as the number of flake scars / kg of raw material, is shown in Table 3.

Table 3. Average values of attributes defining the intensity of flaking.

<table>
<thead>
<tr>
<th>Average</th>
<th>Flake scars</th>
<th>Weight</th>
<th>Flaking index</th>
</tr>
</thead>
<tbody>
<tr>
<td>cores (24)</td>
<td>8</td>
<td>205.45</td>
<td>67.5</td>
</tr>
<tr>
<td>debitage (100)</td>
<td>2.51</td>
<td>29.3</td>
<td>215.95</td>
</tr>
<tr>
<td>retouched (40)</td>
<td>2.89</td>
<td>41.75</td>
<td>217.81</td>
</tr>
</tbody>
</table>

On the whole, this cursory inspection of the main technological features suggests that stoneworking was essentially limited to hard-hammer percussion flaking on local fluvial pebbles, without any careful preparation of surfaces nor the complete exploitation of raw material. Reduction processes were quite simple, and the availability of flint in the limestone and at the surface of the pediment allowed an almost expedient technology. We do not observe a conscious morphological pattern in this lithic production.

General Remarks and Comparisons

The Dauqara assemblage has been recovered from different layers and localities within the same sedimentary body. It is highly probable that the result of this - necessary - confusion would not only be a palimpsest from a diachronic point of view, but also the mixing of sites with different taphonomic history and behavioral significance. Nevertheless, this is often the kind of context the archaeologist deals with when facing very old cultural remains. The same situation, in which the chronology embraces a time span of unknown duration, occurs in other contemporaneous formations, as at El Khattab or Borj Kinnarit. More substantive reference localities, such as 'Ubeidiya or Latamne, have a better chronological control, the former because a relative sequence of the different units is possible, the latter because, at least its most important site (the living floor) is considered the result of a short term occupation (COPELAND and HOURS 1993). For a first comparative look at Dauqara industry, in Table 4 we match the broader artifact classes of the most relevant sites of Early and Middle Acheulean age in the Levant:

\(^1\) Only considered scars >10mm.
Menahem assemblage. (The high debitage percentage for Borj Kinnarit, with a total of only 16 interesting resemblances between Dauqara and other Early Acheulean assemblages: in fact Dauqara the Dauqara artifacts consist of simple flakes; this is almost the same percentage of the Kefar Menahem, has the same percentage of flake tools as ‘Ubeidiya, almost the same percentage of polyhedrons and spheroids, seems to pertain to the Early Acheulean tradition of the Rift (COPELAND and HOURS 1993: 72).

Kefar Menahem is an open-air possible quarry between the Dead Sea and the Mediterranean coast of Israel. Among the 185 shaped tools there is a plurality of choppers (28%) and scrapers (27%). Judging from the illustrated pieces, one light-duty tool has impressive resemblances with our industry from Dauqara Formation. It is the case of the awl of Fig. 7 (GILEAD and ISRAEL 1975: 9), which is very similar to N. 73 of Site 330 Sukhne North (Fig. 4:3). The few handaxes of the lowermost unit are roughly shaped and morphologically undefined. On the whole site, the authors proposed a broad parallel with ‘Ubeidiya Early Acheulean.

At the sandstone quarry of ‘Evron (Israeli Mediterranean coast), in a rescue excavation an in situ assemblage was recovered. The huge handaxes look like the ones from Unit K6 of ‘Ubeidiya, although the latter is considered slightly older (GILEAD and RONEN 1977). The authors proposed a Mindel age on the basis of a closer likeness to the Latamne industry owing to the type of stone-working, the low number of choppers and a broad correspondence of the fauna.

Two sites in Lebanon need special attention: at Borj Kinnarit, a beach formation attributed to the Günz-Mindel interglacial gave a small assemblage without handaxes or flake-tools (HOURS and SANLAVILLE 1972). It is worth noting that among 17 recovered artifacts, there are 10 flakes and 2 cores. The two choppers are quite different from the known Oldowan industry. At the site of Sitt Markho, Lebanon, 90 artifacts have been recovered, 17 of which were classified as tools. The deposit pertains to the Qf IV Formation (HOURS 1981). These assemblages, though very poor, are important because of their chronostratigraphic attribution prior to the Middle Acheulean.

For this latter period, the reference site is Latamne. We have included all the industries of the homonymous formation and not only the assemblages from the living floor. Joubb Jannine, though a surface site, has also been considered because of the high number of artifacts and the almost certain chronological attribution proposed by Besançon et al. (1982).

The Jordanian sites of Abu Habil and Abu el Khas - on the contrary - have been excluded from this comparison because of the attribution to the Tabaqat Fahl Formation (Late Acheulean), based on new detailed stratigraphic work (MACUMBER 1992, WALMSEY et al. 1993, WRIGHT 1993).

Debitage is the most relevant class in all the assemblages reported in Table 4. Almost 70% of the Dauqara artifacts consist of simple flakes; this is almost the same percentage of the Kefar Menahem assemblage. (The high debitage percentage for Borj Kinnarit, with a total of only 16 artifacts, is suspicious) If we repeat the comparison excluding the debitage, we can perceive some interesting resemblances between Dauqara and other Early Acheulean assemblages: in fact Dauqara has the same percentage of flake tools as ‘Ubeidiya, almost the same percentage of polyhedrons and discoids as at Khattab, and Dauqara is devoid of handaxes, exactly as at Borj Kinnarit and - it is to be stressed as the lowermost layers of ‘Ubeidiya. The extremely low frequency of choppers (just one

Some points should be stressed regarding the comparative criteria employed in Table 4:1) In order to adapt our classification to the generally utilized "pebble-centered" terminology, our globular and subdiscoidal cores have been "translated" into polyhedrons and spheroids, a category which has a very broad sense for the authors reviewed; 2) the "debitage" class includes not only the real debitage, but also the dubious tools, which can be considered -at least- as simple debitage.

Because the cultural subdivision of ‘Ubeidiya does not perfectly fit with the chronology based on biostratigraphy, we prefer to consider the assemblage of this site as a whole, pertaining to Lower Pleistocene. In any case, the bulk of the industry is contained in the Fi member, and the whole sequence is estimated to represent a short lapse of time.

The artifacts recovered in the terrace of El-Khattab are of the Qf IV Formation, older than the lowermost Latamne Formation. The small assemblage recovered, devoid of handaxes and essentially composed of choppers, polyhedrons and spheroids, seems to pertain to the Early Acheulean tradition of the Rift (COPELAND and HOURS 1993: 72).

Table 4. Comparison among Early and Middle Acheulean Levantine sites per tool classes: 1 choppers; 2 polyhedrons, discoids; 3 handaxes; 4 cores; 5 heavy duty; 6 flake tools; 7 debitage. Middle Acheulean sites at the top of the table.

<table>
<thead>
<tr>
<th></th>
<th>1 %</th>
<th>2 %</th>
<th>3 %</th>
<th>4 %</th>
<th>5 %</th>
<th>6 %</th>
<th>7 %</th>
<th>TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latamne</td>
<td>63</td>
<td>34</td>
<td>55</td>
<td>456</td>
<td>230</td>
<td>19.09</td>
<td>0.91</td>
<td>56</td>
</tr>
<tr>
<td>Joubb Jannine</td>
<td>147</td>
<td>255</td>
<td>372</td>
<td>192</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>204</td>
</tr>
<tr>
<td>Dauqara 1980</td>
<td>1</td>
<td>9</td>
<td>3.70</td>
<td>-</td>
<td>20</td>
<td>8.23</td>
<td>-</td>
<td>49</td>
</tr>
<tr>
<td>Dauqara TOT</td>
<td>2</td>
<td>12.5</td>
<td>4.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Kefar Menahem</td>
<td>47</td>
<td>2.3</td>
<td>5</td>
<td>0.24</td>
<td>-</td>
<td>118</td>
<td>5.78</td>
<td>-</td>
</tr>
<tr>
<td>Borj Kinnarit</td>
<td>2</td>
<td>12.5</td>
<td>0.91</td>
<td>-</td>
<td>12</td>
<td>12.5</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Khattab</td>
<td>7</td>
<td>31.8</td>
<td>9.09</td>
<td>1</td>
<td>4.55</td>
<td>1</td>
<td>4.55</td>
<td>10</td>
</tr>
<tr>
<td>‘Ubeidiya TOT</td>
<td>895</td>
<td>10.82</td>
<td>418</td>
<td>4.59</td>
<td>219</td>
<td>2.41</td>
<td>140</td>
<td>0.86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1 %</th>
<th>2 %</th>
<th>3 %</th>
<th>4 %</th>
<th>5 %</th>
<th>6 %</th>
<th>7 %</th>
<th>TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>12.5</td>
<td>4.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Latamne</td>
<td>63</td>
<td>34</td>
<td>55</td>
<td>456</td>
<td>230</td>
<td>19.09</td>
<td>0.91</td>
<td>56</td>
</tr>
<tr>
<td>Joubb Jannine</td>
<td>147</td>
<td>255</td>
<td>372</td>
<td>192</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>204</td>
</tr>
<tr>
<td>Dauqara 1980</td>
<td>1</td>
<td>9</td>
<td>3.70</td>
<td>-</td>
<td>20</td>
<td>8.23</td>
<td>-</td>
<td>49</td>
</tr>
<tr>
<td>Dauqara TOT</td>
<td>2</td>
<td>12.5</td>
<td>4.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Kefar Menahem</td>
<td>47</td>
<td>2.3</td>
<td>5</td>
<td>0.24</td>
<td>-</td>
<td>118</td>
<td>5.78</td>
<td>-</td>
</tr>
<tr>
<td>Borj Kinnarit</td>
<td>2</td>
<td>12.5</td>
<td>0.91</td>
<td>-</td>
<td>12</td>
<td>12.5</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Khattab</td>
<td>7</td>
<td>31.8</td>
<td>9.09</td>
<td>1</td>
<td>4.55</td>
<td>1</td>
<td>4.55</td>
<td>10</td>
</tr>
<tr>
<td>‘Ubeidiya TOT</td>
<td>895</td>
<td>10.82</td>
<td>418</td>
<td>4.59</td>
<td>219</td>
<td>2.41</td>
<td>140</td>
<td>0.86</td>
</tr>
</tbody>
</table>

It is worth noting that among 17 recovered artifacts, there are 10 flakes and 2 cores. The two choppers are quite different from the known Oldowan industry. At the site of Sitt Markho, Lebanon, 90 artifacts have been recovered, 17 of which were classified as tools. The deposit pertains to the Qf IV Formation (HOURS 1981). These assemblages, though very poor, are important because of their chronostratigraphic attribution prior to the Middle Acheulean.
A particular feature of Dauqara is the presence or absence of handaxes in the Levantine Acheulean, as already mentioned by Francis Hours (1981), which could have more of a geographical than a chronological meaning.

Conclusions

Age of the Formation

A first dating for the Dauqara Formation is presently available on the basis of three different criteria: biostratigraphy, morphostratigraphy, and archaeology. It is to be stressed that each of them needs further testing: the chronology proposed here will be possibly modified in the future.

Two of the three identified species of Sukhne North, *Mammuthus meridionalis* and *Equus cf. tabeti*, have been recognized in the 'Ubeidiya Formation (Lower Pleistocene). They became extinct at about 0.9 my, at the upper limits of biozone 19, to which the 'Ubeidiya formation is assigned. The third taxon is represented by *Bos primigenius*, well known in Europe after 1my (GUÉRIN and FAURE 1988). In the Levant its oldest remains have been identified in the Latamne Formation, now attributed to the upper biozone 22, some 0.6my old (GUÉRIN *et al.* 1993b).

The morphostratigraphic scheme proposed by Besançon and Hours (1985) for the Zarqa Valley assigned to Dauqara Formation a relative position corresponding to QflII formation in the Orontes River valley, Syria. Nevertheless, a slightly older estimated age is reported in Baubron *et al.* (1985: Table 2). In that paper the authors included the beginning of the Dauqara complex within the Lower Pleistocene, correlating Dauqara to the Erk el Ahmar formation (Villafranchian), Hishmar Hayarden (Qf IV) and 'Ubeidiya Formation.

The lithic assemblage we recovered, quite limited till now, is clearly devoid of handaxes and shows, on the whole, a closer proximity to the Lower than to the Middle Acheulean cultural tradition. Nevertheless, the choppers are also very rare and a subdiscoidal debitage is present, pointing to a more advanced phase than the 'Ubeidiya Developed Oldowan.

In summary, it seems probable that the Dauqara Formation fills the lower part of the gap already mentioned in Guérin and Faure (1988), regarding the biozones 20-22, and that it could be assigned to the final biozone 19 or to the beginning of biozone 20, with an estimated age between 0.9 and 1 my.

Future Work

The results we have presented clearly point to a more fruitful situation than previously supposed for the Quaternary of the eastern side of the Levantine Rift. Not only promising archaeological evidence has been recovered from a formation that, on the present state of knowledge, we shall attribute at least to the beginning of Middle Pleistocene, but we are facing the possibility of decoding a missing chapter in Near Eastern palaeoenvironmental history. As the reader can understand, incipient research has many more questions than resolved problems. What we should like to know is virtually unknown: the time span of the formation studied, the taphonomy of the fossils, the location of primary archaeological sites.

We can define the most important short and middle term research steps: 1) collection of samples for an independent chronology of the formation by radiometric dating or palaeomagnetism; 2) excavation of a small portion of Site 330 for recovery of more faunal and archaeological remains; 3) mapping of different sedimentary facies within the formation by test pits and augering. It is worth noting that the conditions allowing the preservation of primary undisturbed sites are very local ones. It is possible that the "fresher" lithic remains recovered in fine-grained units from other sections of Dauqara Formation may be the remains of nearby archaeological localities that experienced a lesser amount of diagenetic alteration. The primary task of our future work in the area will be both a contextual analysis at the micro-regional scale and the identification of behaviourally meaningful sites.

The Elephant Tooth (Appendix by Claude Guérin)

The most relevant fragment pertains to a permanent molar; the scanty conditions of the tooth do not allow any recognition of its rank or symmetry. It is composed of three laminae, one of which is incomplete. The outline of laminae (the sinuosity of enamel, sketch of median sinus) accords very well with the genus *Mammuthus*. Four of the attributes proposed by M. Beden (1979) can be applied and allow the attribution at the specific level: it is *Mammuthus meridionalis* (Nesti, 1825). In fact: 1) the thickness (e) of the enamel strip is between 2.5 and 4mm; this value excludes a deciduous molar; 2) the width (f) is ≥ 88 mm; 3) the estimated height is 170mm; 4) the laminar frequency (F), obtained with the infra-laminar distance, is about 5.2.
The Jordanian specimen pertains to the same species of the 'Ubeidiya elephant, which is close to subspecies *tamanensis* (DOUBROVO 1964). Among the four attributes considered, three are consistent with the latter (BEDEN 1986); for the two last molars, the enamel thickness is between 2.2 and 3.5mm, width is between 83 and 99mm, laminar frequency is between 4.5 and 7. The height alone is smaller at 'Ubeidiya (a maximum of 144mm), showing that the Jordan elephant is a more advanced and thus recent one. The species *M. meridionalis* spans between 2 and 0.9 million years. Since the 'Ubeidiya specimen is dated at 1.4 million years, the Jordan one can be aged at about one million years.

Because of the bad preservation of the tooth fragment, it is impossible to assign it to one or another defined subspecies of *Mammuthus meridionalis*. This species is already known in the Levant, at Braghite in the Nahr el-Kebir in Lebanon (MALEZ and KANSOU 1974), Hama and Latamne in the Orontes River valley, Syria (HOOIJER 1961, 1962, 1965), and in Turkey (SENYUREK 1960).

**Acknowledgements:** Funding for the 1996 campaign was provided by the Italian Ministry of Foreign Affairs and by Yarmouk University, Irbid. We would like to thank the members of the mission who participated in the palaeolithic survey: P. Macrì, M. Wilson, F. Benedettucci, Muwaffaq Bataineh and the representative of the Department Antiquities Ahmad Ajaj. We would also like to thank Silvana Vitagliano, Clarissa Belardelli, Claudio Giardino for valuable comments and Vittorio Gabrieli for the revision of the English draft of the paper.

**Fabio Parenti, Ernesto Santucci, and Gaetano Palumbo**  
*Missione archeologica italo-giordana*  
*Dipartimento di Scienze Storiche Archeologiche e Antropologiche dell'Antichità*  
*Università degli Studi di Roma "La Sapienza"*  
*Sez. Vicino Oriente*  
*Via Palestro 63*  
*00185 Roma, Italy*

**Abdel Halim Al-Shiyab and Zeidan Kafafi**  
*Institute of Archaeology*  
*Yarmouk University*  
*Irbid, Jordan*

**Claude Guérin**  
*Centre de Paléontologie stratigraphique et Paléoécologie*  
*Département des Sciences de la Terre*  
*Université Lyon I - Claude Bernard*  
*69622 Villeurbanne Cedex, France*

**Bibliography**

BAR-YOSEF O.  

BAR-YOSEF O. and GOREN-INBAR N.  

BAUBRON J.C., BESANÇON J., COPELAND L., HOURS F., MACAIRE J.J., and SANLAVILLE P.  

BEDEN M.  
1979 Les éléphants (Elephas et Loxodonta) d'Afrique orientale. Systématique, phylogénie, intérêt biochronologique. Potiers, Université Poitiers: Thèse de Doctorat d'État,  

BESANÇON J. and HOURS F.  

BESANÇON J., COPELAND L., and HOURS F.  
BESANÇON J., COPELAND L., and SANLAVILLE P.
Amman, Department of Antiquities.

BESANÇON J., COPELAND L., HOURS F., MACAIRE I., and SANLAVILLE P.

COPELAND L. and HOURS F.

COPELAND L. and HOURS F.

DAVIS S.

DÉBARD E., FAURE M., and GUÉRIN C.

DOUBROVO
1964 Rerartition des Arkidiskodons sur le territoire de l'URSS. Palaeontological Journal Moscow 3: 82-94.

EISENMANN V.

GILEAD D. and ISRAEL M.

GILEAD D. and RONEN A.
1977 Acheulean industries from 'Evron on the western Galilee coastal plain. Eretz-Israel 13: 56-86.

GOREN-INBAR N.

GUÉRIN C., BAR-YOSEF O., DEBARD E., FAURE M., SHEA I., and TCHERNOV E.

GUÉRIN C., EISENMANN V., and FAURE M.

GUÉRIN C. and FAURE M.

HOOIJER D.A.

HOURS F.
HOURS F. and SANLAVILLE P.

HUCKRIEDE R.

ISAAC G.L.

MACUMBER P.

MALEZ M. and KANSOU M.

PALUMBO G., KAFAZI F., PARENTI F., SANTUCCI E., WILSON M., and AL-SHIYAB A.H.

SANLAVILLE P.

SHACKLEY M.L.

SENYUREK M.

TCHERNOV E. and GUÉRIN C.

TURNBULL P. and REED C.
1974 The fauna from the terminal Pleistocene of Palegawra Cave (Iran). Fieldiana Anthropology 63.3: 81-146.

VILLIERS L.

WALMSLEY A., MACUMBER P.G., EDWARDS P., BOURKE S., and WATSON P.

WRIGHT R.